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Uranium content in human urine

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Abstract : The present study is an investigation of the trace content of uranium in human urine (normal and cancer patients) by using nuclear etch technique. The uranium content in the urine of normal persons has been found to vary from (0.037 ± 0.002) to (0.068 ± 0.003) micrograms/litre and in case of cancer patient it varies from (0.035 ± 0.002) to (0.070 ± 0.003) micrograms/litre.

No difference has been observed between the two groups as regards the uranium content of urine. It indicates that the elimination of uranium through urine is of same level in both the cases.

Keywords : Trace-element, human urine, SSNTD.

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1. Introduction

Trace elements are the chemical elements, which play the subtle role in the life process of plants and animals. Uranium is one of such trace elements which can be absorbed in trace amounts by living species as a result of food chain and environmental conditions. Normal metabolism can eliminate the excess of this element. Urine being one of such metabolic waste products ; uranium can be eliminated through it.

The estimation of uranium in human blood (normal persons, diseased persons, professional X-ray workers and cancer patients) was initiated by a few workers (Das *et al* 1986, Das and Goswami 1987, Das 1988, Segovia *et al* 1986). It has been reported that in the first three groups of population there are no difference as regards their U-content of blood. It is interesting to note that in the case of cancer patients the U-content of blood is slightly higher than the other groups. This higher value of uranium content in the blood of cancer patients may be due to possible differences in one's power of absorption, retention and also of elimination of the element. As such the estimation of the element in urine is essential to collect information in this area of investigation.

Therefore in the present study, we have made an effort to estimate the uranium content in the urine of two groups of human populations namely a group of normal persons and another group of cancer patients.

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2. Experimental procedure

SSNTD method (Price and Walker 1963) has been applied in the present study with the following conventional procedure.

Known volume (0.02 ml) of urine samples collected from different individuals are placed on separate pieces of lexan sheets (1.3 cm in diameter), which are used here as external detector. The samples are then dried at 70°C leaving behind a thin film of non-volatile residue of urine on the detector. Each detector having the non-volatile residue on its surface is then covered with another detector of same size to constitute one pellet. Thus, numbers of such pellets were prepared from the urine of different individuals.

The pellets along with three pieces of standard glass used as flux dosimeter were placed in an aluminium can which was irradiated to a known dose ($\sim 10^{13}$/ cm^2/sec, for one hour) of thermal neutrons at CIRUS reactor, BARC, Bombay. After exposure, the external detectors were etched in 6N NaOH solution at a temperature of 70°C ± 1°C for a period of 25–30 minutes to reveal the fission tracks due to U^{235} present in the urine samples. The tracks so revealed were then counted under a magnification of 640X in an optical microscope.

The concentration of uranium in the urine samples in units of weight per volume of urine, is calculated using the following relation (after putting the values of constants in the formula given by Fleischer and Lovette 1968).

$$U_{conc.} = \frac{94.1\ T}{V\phi}\ \text{gm/cc}$$

where

T = Total number of tracks observed
V = Volume of urine taken
ϕ = Thermal neutron dose (nvt)

3. Results

The results of uranium content obtained in various urine samples are shown in Tables 1 and 2. Table 1 gives the uranium content of urine from fifteen normal persons of both the sexes. The uranium contents are found to vary from (0.037 ± 0.002) to (0.068 ± 0.003) micrograms/litre with a mean value, 0.050 micrograms/litre. Table 2 shows the uranium content of urine from fifteen cancer patients of both sexes. The content varies from (0.035 ± 0.002) to (0.070 ± 0.003) micrograms/litre with a mean value, 0.052 micrograms/litre.

4. Discussion

The data presented on Table 3 shows that uranium absorbed through food chain varies from ppb to ppm level (Baruah and Goswami 1983, Choudhury and Goswami

Table 1. U-Content in human urine (normal persons).
$V = 0.02$ ml of urine
$\phi = 2.96 \times 10^{16}$ (neutron fluence)

Sample No.	Sex	Age in years	Total no. of tracks observed/ samples	U-content in micrograms/ litre
1	Male	44	367	0.059 ± 0.003*
2	,,	29	298	0.047 ± 0.002
3	,,	50	263	0.041 ± 0.002
4	,,	63	327	0.051 ± 0.002
5	,,	47	361	0.057 ± 0.002
6	,,	55	248	0.039 ± 0.002
7	,,	30	353	0.056 ± 0.002
8	,,	38	305	0.048 ± 0.002
9	Female	64	251	0.039 ± 0.002
10	,,	43	401	0.063 ± 0.003
11	,,	28	433	0.068 ± 0.003
12	,,	36	382	0.060 ± 0.003
13	,,	53	281	0.044 ± 0.002
14	,,	27	233	0.037 ± 0.002
15	,,	58	346	0.054 ± 0.002

*Errors indicated here represent the errors of statistical counting.

Table 2. U-Content in human (cancer patients) urine
$V = 0.02$ ml of urine
$\phi = 2.96 \times 10^{16}$ (neutron fluence).

Sample No.	Sex	Age in years	Total no. of tracks observed/sample	U-content in micrograms/ litre
1	Male	33	239	0.037 ± 0.002*
2		51	349	0.055 ± 0.003
3		44	276	0.043 ± 0.002
4		61	404	0.064 ± 0.003
5		37	267	0.042 ± 0.002
6		59	443	0.070 ± 0.003
7		36	381	0.060 ± 0.003
8		46	275	0.043 ± 0.002
9	Female	43	260	0.041 ± 0.002
10		55	369	0.058 ± 0.003
11		57	225	0.035 ± 0.002
12		46	385	0.061 ± 0.003
13		29	343	0.054 ± 0.003
14		30	413	0.065 ± 0.003
15		37	398	0.063 ± 0.003

*Errors indicated here represent the errors of statistical counting.

Table 3. Uranium content in plants, water and milk.

	Workers	Sample	U-content in ppm
1	Baruah and Goswami (1983)	Medicinal plants	(0.19 to 2.83)
2	Choudhury and Goswami (1985)	Betel leaves	(0.8 to 1.3)
		Betel nut	1.1
		Tabacco leaves	1.0
3	Hanifa (1985)	Water from natural sources	0.39 ppb
		Cow milk	0.08 to 0.15 ppb

1985, Hanifa 1985). It is expected to be absorbed in the alimentary canal through which it comes to blood. It has also been found (Das and coworkers 1986, 1987, 1988) that the uranium content of blood in case of human beings is in ppb level ($\sim$ 0.87 micrograms/litre). As a result of metabolic activities some of uranium present in blood may be eliminated through urine. From the present investigation, it has been observed that mean U-content for normal human urine is 0.050 micrograms/litre. It shows that the U-content of urine is much lower than the U-content of blood.

Further, the U-content of blood in case of cancer patients, is found to be about three times higher (2.87 micrograms/litre) than that of normal one (Das and Goswami 1987, Segovia *et al* 1986). One of the probable causes for high abun-

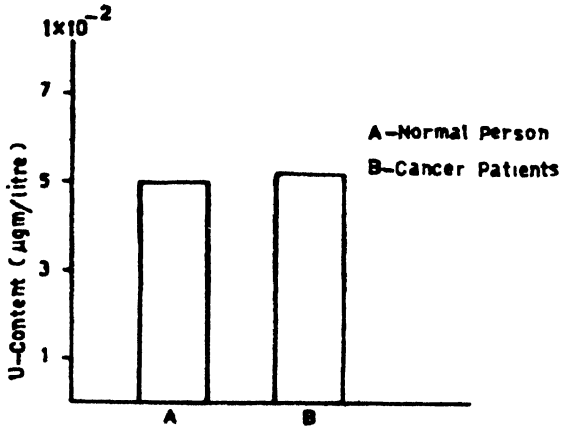

Figure 1. Mean U-content in human urine (normal and cancer patients).

dance of uranium in case of cancer patients is due to different individual power of elimination of the element. But the present study shows that the mean U-content for normal human urine is 0.050 micrograms/litre where as for cancer patients the

mean U-content is 0.052 micrograms/litre (Figure 1). These results show no significant difference in U-content of urine between the two groups. It indicates that both the groups eliminate same level ($\sim$ 0.051 micrograms/litre) of uranium through urine. Hence, it may not be convincing to conclude that excess amount of uranium in blood of cancer patients is due to different power of elimination of the element through urine.

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